



**ROYAL SCHOOL OF ENGINEERING &
TECHNOLOGY
(RSET)**

DEPARTMENT OF CIVIL ENGINEERING

**COURSE STRUCTURE & SYLLABUS
(BASED ON NATIONAL EDUCATION POLICY 2020)**

FOR

**Master of Technology
in**

Structural Engineering

W.E.F

AY - 2025 – 26

Course Structure

(AY 2025-26 onwards)

Semester I

Sl. No	Course Code	Course Name	Hours per week			Credit
			L	T	P	C
1	CEE024C10S1	Advanced Structural Analysis	3	1	0	4
2	CEE024C10S2	Continuum Mechanics	3	1	0	4
3	CEE024C10S3	Structural Dynamics	3	1	0	4
4	CEE024C10S4	Numerical Methods	3	1	0	4
5	CEE024C10S5	Disaster Management	1	0	0	1
6	CEE024C11S6	Structural Engineering Lab	0	0	2	1
7	CEE024D10Sx	Elective-I	3	0	0	3
8	CEE024D10Sx	Elective-II	3	0	0	3
TOTAL			19	4	2	24

Semester II

Sl. No	Course Code	Course Name	Hours per week			Credit
			L	T	P	C
1	CEE024C20S1	Finite Element Method	4	0	0	4
2	CEE024C20S2	Computer Aided Analysis & Design of Structures	4	0	0	4
3	CEE024C20S3	Earthquake Engineering	4	0	0	4
4	CEE024C20SW1	Research Methodology & IPR	3	0	0	3
5	CEE024D20Sx	Elective-III	3	0	0	3
6	CEE024D20Sx	Elective-IV	3	0	0	3
TOTAL			21	0	0	21

Semester III

Sl. No	Course Code	Course Name	Hours per week			Credit
			L	T	P	C
1	CEE024C30S1	Repair & Retrofitting of Structures	3	0	0	3
2	CEE024D30Sx	Elective-V	3	0	0	3
3	CEE024C32SW1	Dissertation: Phase – I	0	0	0	14
4	CEE024C33SW2	Summer Training	0	0	0	1
TOTAL			6	0	0	21

Semester IV

Sl. No	Course Code	Course Name	Hours per week			Credit
			L	T	P	C
1	CEE024C42SW1	Dissertation: Phase – II	0	0	0	18
TOTAL			0	0	0	18

SEMESTER	CREDITS
I	24
II	21
III	21
IV	18
Total	84

Elective – I

Sl.No.	Code	Course
1	CEE024D10S1	Theory of Structural Stability
2	CEE024D10S3	Advanced Concrete Technology

Elective – II

Sl.No.	Code	Course
1	CEE024D10S2	Analysis & Design of Bridges
2	CEE024D10S4	Soil Structure Interaction

Elective – III

Sl.No.	Code	Course
1	CEE024D20S1	Design of High-Rise Structures
2	CEE024D20S2	Project Management

Elective – IV

Sl.No.	Code	Course
1	CEE024D20S3	Applications of GIS in Structural Engineering
2	CEE024D20S4	Advanced Structural Design

Elective – V

Sl.No.	Code	Course
1	CEE024D30S1	Design of Prestressed Concrete Structures
2	CEE024D30S2	Analysis and Design of Deep Foundation

Semester I

Advanced Structural Analysis (CEE024C10S1)

Scheme of Evaluation: T

L-T-P-C: 3-1-0-4, Credit Units: 04

Pre-requisite: Structural Analysis

Course Objectives:

The course aims to build a strong foundation in matrix-based structural analysis by introducing key concepts such as degrees of freedom, indeterminacy, and the basics of flexibility and stiffness methods. It focuses on the development and application of the stiffness method for analyzing trusses, beams, and frames. Students will also gain an understanding of plastic behavior in structures, including the formation of plastic hinges and collapse mechanisms, enabling them to evaluate ultimate load-carrying capacities. Additionally, the course covers approximate analysis techniques for estimating internal forces in indeterminate building frames, supporting efficient preliminary design.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Recall key concepts in structural behavior and matrix analysis methods.	BT 1
CO 2	Interpret the stiffness and flexibility approaches in structural analysis.	BT 2
CO 3	Apply matrix and plastic analysis techniques to solve structural problems.	BT 3
CO 4	Analyze indeterminate structures using exact and approximate methods.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction to Matrix Method: Review of basic structural analysis concepts, degrees of freedom, static and kinematic indeterminacy, classification of structures, fundamentals of flexibility and stiffness methods, and introductory examples illustrating their application.	16
II	Stiffness Method: Development of stiffness matrices for truss, beam, and frame elements, formation of the global structure stiffness matrix, application to continuous beams, pin-jointed frames, and rigid frames.	15
III	Plastic Analysis: Basics of plastic behavior of materials, concept of plastic hinges, collapse mechanisms, determination of plastic moment capacity and shape factors, upper and lower bound theorems.	14
IV	Approximate Analysis of Indeterminate Structures: Need for approximate methods, basic assumptions, analysis of building frames under vertical and lateral loads using portal and cantilever methods, estimation of internal forces, application in preliminary design.	15
	Total	60

Text/Reference Books:

1. Hibbeler, R.C., Structural Analysis, Pearson
2. Thandavamoorthy, T.S., Structural Analysis, Oxford University Press
3. Weaver, W. and Gere, J.M., Matrix Analysis of Framed Structures, CBS Publisher
4. Wang, C.K., Intermediate Structural Analysis, McGraw Hill
5. Kanchi, M.B., Matrix Methods of Structural Analysis, Wiley Eastern Limited

Continuum Mechanics (CEE024C10S2)

Scheme of Evaluation: T

L-T-P-C: 3-1-0-4, Credit Units: 04

Pre-requisite: Mechanics of Solids

Course Objectives:

The course aims to provide a thorough understanding of the mechanics of continuous media by introducing fundamental concepts such as tensor algebra, stress-strain relationships, and compatibility conditions. It enables students to analyze boundary value problems in elasticity using analytical techniques in both Cartesian and polar coordinates. The course also introduces the basic principles of plasticity, including yield criteria and hardening behavior. Additionally, it covers energy-based and variational methods, equipping students with tools like Hamilton's principle and the Rayleigh-Ritz method for solving complex structural problems.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Remember basic concepts of stress, strain, and tensor algebra.	BT 1
CO 2	Understand stress function approaches under plane stress and plane strain conditions.	BT 2
CO 3	Apply yield criteria and plasticity concepts to material behavior under complex loading.	BT 3
CO 4	Analyze structural problems using energy principles and variational methods.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Basic Concepts of the Theory of Continuous Media: Introduction to tensor algebra; theory of stresses; infinitesimal and finite strains; strain-displacement relationships; compatibility; stress-strain relationships.	15
II	Boundary Value Problem in Elasticity: Plane stress and plane strain case; stress function approaches; plane problems in Cartesian and polar coordinates; bending of a beam; thick cylinder under pressure.	15
III	Concept of Plasticity: Elements of plasticity; yield criteria; flow rule and hardening. Plastic stress-strain relationships.	15
IV	Energy Principles and Methods of Analysis: Energy principles, variational methods and numerical methods; Introduction to Hamilton's principles; Rayleigh-Ritz and Weighted residual methods.	15
	Total	60

Text/Reference Books:

1. D. S. Chandrasekharaiah and L. Debnath, Continuum Mechanics, Prism Books Pvt. Ltd., Bangalore, 1994.
2. S. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw Hill Book Company, International Ed, 1970.
3. J. Chakrabarty, "Theory of Plasticity", 3rd Edition, Elsevier Butterworth, Heinmann, UK, 2006.
4. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.
5. Ansel. C. Ugural and Saul. K. Fenster, "Advanced Strength and Applied Elasticity," 4th Edition, Prentice Hall Professional Technical Reference, New Jersey, 2003

Structural Dynamics (CEE024C10S3)

Scheme of Evaluation: T

L-T-P-C: 3-1-0-4, Credit Units: 04

Pre-requisite: Nil

Course Objectives:

The objective of this course is to equip students with advanced knowledge of earthquake engineering principles, focusing on the analysis and design of structures subjected to seismic forces. Students will develop skills to critically evaluate and apply seismic design codes, analyze the dynamic response of structures, and assess geotechnical aspects related to earthquakes, such as soil behavior and liquefaction.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define fundamental principles and equations of motion for Single Degree-Of-Freedom (SDOF) systems, including free and forced vibrations.	BT 1
CO 2	Understand the behavior of Multiple Degree-Of-Freedom (MDOF) systems, including natural frequencies, mode shapes, and the concepts of modal analysis.	BT 2
CO 3	Apply structural dynamics principles to Continuous Systems	BT 3
CO 4	Analyze the dynamic behavior of block and frame foundations, as well as chimneys	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Single Degree-Of-Freedom (SDOF) Systems: Equations of motion, free vibration, damping, energy dissipated in viscous damping, forced vibrations under harmonic, impulse and general loadings, Fourier analysis and response due to periodic and non-periodic loading, generalized coordinates and Rayleigh's method.	15
II	Multiple Degree-Of-Freedom (MDOF) Systems: Equations of motion, natural frequencies, mode shapes, modal participation factor, damping matrix, orthogonality condition, analysis of dynamic response - modal superposition method; mode acceleration method, reduction of dynamic matrices, error in dynamic analysis. Numerical methods in dynamics: eigen value analysis, direct integration scheme.	15
III	Continuous Systems: Equations of motion, Hamilton's principle, Lagrangian formulation, longitudinal vibration, transverse vibration, introduction to random vibration.	15
IV	Application of Structural Dynamics: Design of block and frame foundation, chimney.	15
	Total	60

Text/Reference Books:

1. Anil K. Chopra, Dynamics of structures: Theory and applications to earthquake engineering, PHI Ltd.
2. R.W. Clough and J. Penzien, Dynamics of Structures, Second edition, McGraw Hill international edition.
3. Humar J. L., Dynamics of Structures., Prentice Hall
4. Mario Paz, Structural dynamics, CBS Publishers.
5. K. Rao, Vibration analysis and foundation dynamics, Wheeler.
6. E. Siniu and R. H. Scanlan, Wind effects on structures: fundamentals and applications to design, John Wiley and Sons

Numerical Methods (CEE024C10S4)

Scheme of Evaluation: T

L-T-P-C: 3-1-0-4, Credit Units: 04

Pre-requisite: Nil

Course Objectives:

To equip postgraduate civil engineering students with advanced numerical and statistical techniques for solving complex engineering problems through differential equations, matrix-based computations, and multivariate data interpretation.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Remember and study errors and curve fitting principle.	BT 1
CO 2	Understand solutions of linear and non-linear equations.	BT 2
CO 3	Apply numerical differentiation and integration techniques to solve differential equations relevant to engineering.	BT 3
CO 4	Analyze engineering data using statistical tools such as regression, correlation, and predictive modeling.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Fundamentals of Numerical Methods: Error Analysis, Polynomial Approximations and Interpolations, Curve Fitting; Interpolation and extrapolation.	15
II	Solution of Non-linear Algebraic and Transcendental Equations: Elements of Matrix Algebra: Solution of Systems of Linear Equations, Eigen Value Problems.	15
III	Numerical Differentiation & Integration: Solution of Ordinary and Partial Differential Equations.	15
IV	Statistical Tools: Bivariate and multivariate data, Simple and multiple correlation. Predictive Analysis: Simple Regression, Multicollinearity, Multiple Regression.	15
	Total	60

Text/Reference Books:

1. An Introduction to Numerical Analysis, Atkinson K.E., J. Wiley and Sons, 1989.
2. Applied Linear Regression, Sanford Weisberg, John Wiley & Sons, Inc, 2005.
3. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series),1988.
4. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.

Disaster Management (CEE024C10S5)

Scheme of Evaluation: T

L-T-P-C: 1-0-0-1, Credit Units: 01

Pre-requisite: Nil

Course Objectives:

This course introduces the fundamental principles and interdisciplinary nature of disaster management, focusing on both natural and man-made disasters. It discusses the classification, causes, consequences, preparedness, and mitigation strategies, with special reference to disaster-prone areas in India. The course aims to enhance risk evaluation capabilities and to foster community-based disaster response and mitigation planning.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define key concepts and distinguish between various types of disasters.	BT 1
CO 2	Classify vulnerable areas and evaluate associated risks.	BT 2
CO 3	Apply preparedness and mitigation strategies at individual and community levels.	BT 3
CO 4	Discover national and international efforts in disaster risk reduction.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Fundamentals of Disaster Management: Introduction to Disaster Management, Definition, Factors, Significance of Disasters, Difference between Hazard and Disaster, Natural Disasters: Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts, Landslides, Avalanches. Man-made Disasters: Industrial Accidents, Oil Spills, Wars, Epidemics.	4
II	Impact and Vulnerability Assessment: Repercussions of Disasters: Economic, Human & Animal Life, Ecosystem, Disaster-Prone Areas in India: Seismic Zones, Floods, Droughts, Coastal Hazards and Tsunamis; Post-Disaster Diseases.	4
III	Risk Reduction and Mitigation: Disaster Preparedness: Monitoring, Evaluation, Remote Sensing, Risk Evaluation: Media, Meteorological Data, Community Preparedness, Concepts of Disaster Risk and Reduction (Global/National Perspectives), Risk Assessment Techniques; Community Participation Global Cooperation & Strategies for Survival, Disaster Mitigation: Concepts & Strategies Structural vs Non-Structural Mitigation Measures, Mitigation Programs in India.	4
IV	Case Study and Simulation: Case Study and Problem-Solving Session, Disaster Response Simulation Exercise.	3
	Total	15

Text/Reference Books:

1. R. Nishith, Singh A.K., Disaster Management in India: Perspectives, Issues and Strategies, New Royal Book Company.
2. Sahni, Pardeep et al. (Eds.), Disaster Mitigation: Experiences and Reflections, Prentice Hall of India.
3. Goel, S. L., Disaster Administration and Management: Text and Case Studies, Deep & Deep Publications Pvt. Ltd., New Delhi.

Structural Engineering Lab (CEE024C11S6)

Scheme of Evaluation: P

L-T-P-C: 0-0-2-1, Credit Units: 01

Pre-requisite: Concrete Technology

Course Objectives:

To develop practical skills in evaluating mechanical and durability properties of structural materials and systems through experimental methods, enabling students to interpret structural behavior under various loading conditions using standard tests and modern instrumentation techniques.

Course Outcome:

After completion of the course, the students will be able to:

- CO1: Characterize Mechanical Properties of Structural Materials
- CO2: Analyze the Structural Response of RC Elements
- CO3: Execute Advanced Concrete Design and Fabrication
- CO4: Implement Non-Destructive Testing and Digital Instrumentation

Total Lab Hours = 30 (2 hours per week)

List of experiments:

1. Correlation between cube strength and cylinder strength
2. Split tensile strength and modulus of rupture
3. Load-deflection behavior of simply supported beams
4. Compressive Strength Test of Masonry Units (Bricks or Blocks)
5. Modulus of elasticity of concrete and steel
6. Shear strength testing of beams
7. Column behavior under axial and eccentric loading
8. Study of slab behavior under uniformly distributed load
9. Concrete Mix Design of High Strength Concrete
10. Casting and Testing of High Strength Concrete Specimens (Compressive, Tensile & Flexural Tests)
11. Rebound Hammer Test
12. Ultrasonic Pulse Velocity Test
13. Core Cutter Test (demo or interpretation)
14. Half-cell Potential and Carbonation Test
15. Instrumentation in Structural Engineering – Use of strain gauges, LVDTs, load cells, and data acquisition systems

Text/Reference Books:

1. Experimental Methods in Structural Engineering by Karuna Moy Ghosh.
2. A Structural Engineering Laboratory Manual by S. Unnikrishna Pillai and Devdas Menon.
3. IS 10262-2019 Guidelines to Concrete mix design.
4. IS-13311 (Part 2):1992 (Reaffirmed- 2013) Non-Destructive Testing of Concrete-Methods of Test (Rebound hammer).
5. IS-13311 (Part 1):1992 (Reaffirmed- 2004) Non-Destructive Testing of Concrete-Methods of Test (UPV).
6. Advanced Concrete Technology, 2nd Edition, Zongjin Li, Xiangming Zhou, Hongyan Ma, Dongshuai Hou.
7. Concrete Technology, 2nd Edition, A.M.Neville , J.J Brooks.
8. IS 456:2000 Plain and reinforced concrete code of practice.

Elective – I: Theory of Structural Stability (CEE024D10S1)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03

Pre-requisite: Mechanics of Solids

Course Objectives:

To enable students to understand the fundamental principles of structural stability and analyze the buckling behavior of columns, beams, frames, and plates using analytical, approximate, and numerical methods.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Recall fundamental concepts of equilibrium and buckling in structural members.	BT 1
CO 2	Interpret energy methods and numerical approaches used in stability analysis.	BT 2
CO 3	Apply stability principles to analyze columns, beam-columns, and frame structures.	BT 3
CO 4	Analyze torsional, lateral, and plate buckling for structural elements under various conditions.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Buckling of Columns: States of equilibrium - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis. Governing equation for column buckling - critical load using Equilibrium, Energy methods - Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques – Finite difference method.	12
II	Buckling of Beam-Columns and Frames: Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples - Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.	11
III	Torsional and Lateral Buckling: Torsional buckling – Combined Torsional and flexural buckling - Local buckling - Buckling of Open Sections - Lateral buckling of beams - simply supported and cantilever beams.	11
IV	Buckling of Plates: Governing differential equation - Buckling of thin plates with various edge conditions - Analysis by equilibrium and energy approach – Finite difference method.	11
	Total	45

Text/Reference Books:

1. Principles of Structural Stability Theory by Alexander Chajes, Prentice Hall, N.J., 1974 by Stephen Timoshenko, Dover Publications inc. New York, 1989
2. Zdenek P. Bazant, Luigi Cedolin, Dover Publications, 2003
3. Theory of elastic stability Stability of structures Z. P. Bažant, · 2006
4. Fundamentals of Structural Stability By George Simitses, Dewey H Hodges, Elsevier Science, 2006

Elective – I: Advanced Concrete Technology (CEE024D10S3)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03

Pre-requisite:

Course Objectives:

This course helps to develop the advanced understanding of modern concrete materials and their behaviour. It introduces the students to study of high-performance and special concrete used in structural applications. The course is aligned to make the students understand durability, deterioration mechanisms and repair technologies. It also introduces the students to the latest advancements such as nanotechnology, smart concrete and sustainability concepts..

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Explain the microstructure, material properties and behaviour of advanced cementitious systems and admixtures. .	BL1, BL2
CO 2	Apply the principles of special concrete such as HPC, SCC, FRC and geopolymer concrete in structural engineering applications. .	BL2, BL3
CO 3	Analyze durability issues, deterioration mechanisms and select appropriate testing and repair techniques for concrete structures.	BL3, BL4, BL6
CO 4	Evaluate and develop sustainable and innovative concrete technologies incorporating nanotechnology, smart materials and life cycle assessment approaches.	BL4, BL5, BL7, BL8

Detailed Syllabus:

Module	Content	Periods
I	Advanced Concrete Materials & Microstructure : Hydration of cement and microstructure development, Properties of fresh and hardened concrete, Mineral and chemical admixtures, Rheology of concrete and workability control, Microstructural characterization techniques	12
II	Special Concretes : High Performance Concrete (HPC) and High Strength Concrete (HSC), Self-Compacting Concrete (SCC): principles, mix design, applications, Fiber Reinforced Concrete (FRC) and, Engineered Cementitious Composites (ECC), Lightweight, cellular, and geopolymer concrete Ultra-High Performance Concrete (UHPC)	11
III	Durability, Deterioration & Repair : Durability concepts and service life prediction, Mechanisms of deterioration: corrosion, carbonation, sulfate attack, alkali-aggregate reaction, Non-destructive testing (NDT) and condition assessment, Repair materials and techniques (grouting, shotcrete, FRP strengthening), Corrosion protection and durability design	11
IV	Sustainability & Advanced Technologies : Sustainable concrete: low-carbon materials and green concrete, Use of recycled aggregates and industrial by-products, Nanotechnology in concrete (nano-silica, nano-modification) Smart concrete (self-healing, self-sensing materials), Life Cycle Assessment (LCA) and performance-based design	11
	Total	45

Text/Reference Books:

- Properties of Concrete, Author: A.M. Neville, – Publisher: Pearson Education
- Concrete Technology, Author: M.S. Shetty, Publisher: S. Chand & Company Ltd.
- Advanced Concrete Technology (Vol. 1–4), Edited by John Newman & Ban Seng Choo, Publisher: Butterworth-Heinemann (Elsevier)

Elective – II: Analysis & Design of Bridges (CEE024D10S2)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03

Pre-requisite: Mechanics of Solids

Course Objectives:

This course introduces students to the fundamental concepts and advanced principles of bridge engineering. It emphasizes the analysis and design of bridge superstructures and substructures considering various types, loading standards, construction materials, and modern analysis techniques including numerical modeling. It also covers codal provisions, prestressing concepts, and earthquake-resistant design aspects for bridges.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Recall bridge types, configurations, and loading standards.	BT 1
CO 2	Interpret design principles and component behavior.	BT 2
CO 3	Apply design procedures for RCC, prestressed, and composite bridges.	BT 3
CO 4	Analyze substructure performance and seismic effects.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction to Bridge Engineering: Types of Bridges, Structural Configurations, Bridge Loading Standards – IRC, IRS, AASHTO, Impact Effect on Bridges.	12
II	Specifications and Preliminary Design: Road Bridge Specifications (IRC), Railway Bridge Specifications (IRS), Introduction to Bridge Deck Analysis, Deck Analysis – Solved Examples, RCC Slab Bridge Design Principles, RCC T-Beam Bridge – Concept and Detailing, Balanced Cantilever Bridges, Bearings and Expansion Joints.	11
III	Prestressed Concrete Bridges, Box Girder and Composite Bridges: Basics of Prestressing (Pre-tensioned and post-tensioned), Flexure, Shear & Bond Analysis Losses in Prestress, Deflection of Girders, Partial Prestressing, Anchorage Block Design, Analysis and Detailing of Box Girder Bridges, Steel-Concrete Composite Construction, Design of Shear Connectors, Types and Layouts of Bearings.	11
IV	Substructure and Foundation Design, Advanced Design and Modeling: Abutments: Functions and Types, Piers: Types and Forces, Scour at Piers and Abutments, Foundation Types, Stress Analysis of Substructure, Basics of Soil-Structure Interaction Basics of Numerical Modeling in Bridge Structures, Earthquake-Resistant Design of Bridges, Case Studies and Recent Developments.	11
	Total	45

Text/Reference Books:

1. D. J. Victor, Essentials of Bridge Engineering, Oxford IBH, 1980.
2. V. K. Raina, Concrete Bridge Practice – Analysis, Design and Economics, Tata McGraw Hill, 2nd Ed., 1994.
3. N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, 2006.
4. T. Y. Lin & N. H. Burns, Design of Prestressed Concrete Structures, John Wiley & Sons, 1981.

Elective – II: Soil Structure Interaction (CEE024D10S4)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03

Pre-requisite:

Course Objectives:

This course introduces the students to the fundamental concepts and significance of soil-structure interaction in civil engineering systems. The course dives into the study of static and dynamic interaction effects on foundations and superstructures so that the ability to analyze soil–foundation–structure systems using analytical and numerical approaches is developed. It also introduces the student to advanced modelling techniques and real-life applications in SSI.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Explain the fundamental concepts of soil–structure interaction, soil behavior, and foundation systems.	BL1, BL2
CO 2	Apply principles of static SSI to analyze foundations and structural systems under various loading conditions.	BL2, BL3
CO 3	Analyze dynamic soil–structure interaction effects, including seismic response and vibration behavior of soil–foundation systems.	BL3, BL4, BL6
CO 4	Evaluate and develop advanced numerical models for SSI problems and assess real-life engineering systems using modern software tools.	BL4, BL5, BL7, BL8

Detailed Syllabus:

Module	Content	Periods
I	Fundamentals of Soil–Structure Interaction : Introduction to SSI: concept and importance; Soil behaviour: elastic, elasto-plastic and nonlinear characteristics; Types of foundations: shallow and deep foundations; Contact pressure distribution and settlement behavior, Subgrade reaction concept (Winkler model) and its limitations	12
II	Static Soil–Structure Interaction : Beam on elastic foundation (Winkler models), Analysis of footings, rafts and piles under static loads; Settlement analysis of foundations; Interaction effects on framed structures Soil–foundation stiffness and its influence on structural response	11
III	Dynamic Soil–Structure Interaction : Fundamentals of structural dynamics related to SSI; Dynamic properties of soil: damping, stiffness, modulus; Machine foundations and vibration analysis; Seismic SSI: kinematic and inertial interaction; Soil amplification and liquefaction effects	11
IV	Advanced Modelling & Applications : Numerical modelling of SSI (FEM, FDM basics); Soil–structure interaction in tall buildings and bridges; Soil–foundation interaction for foundations; Case studies on SSI failures and performance; Software applications	11
	Total	45

Text/Reference Books:

- Advanced Geotechnical Engineering: Soil–Structure Interaction using Computer and Material Models,– Authors: Chandrakant S. Desai & Musharraf Zaman, Publisher: CRC Press (Taylor & Francis Group) .
- Soil–Structure Interaction: The Real Behaviour of Structures, – Author: J.E. Bowles, – Publisher: McGraw-Hill
- Foundation Analysis and Design, Author: Joseph E. Bowles, Publisher: McGraw-Hill

Semester II

Finite Element Method (CEE024C20S1)

Scheme of Evaluation: T

L-T-P-C: 3-1-0-4, Credit Units: 04

Pre-requisite: Advanced Structural Analysis

Course Objectives:

The course is intended to impart knowledge about finite element method used for structural analysis and also to make students enable to operate FEA software.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Recall basic concepts of FEM, element types, stiffness matrices, and equilibrium equations.	BT 1
CO 2	Interpret beam and structural element behaviour using Galerkin method, interpolation functions, and compatibility requirements.	BT 2
CO 3	Apply FEM procedures to solve one-dimensional, two-dimensional, and three-dimensional engineering problems.	BT 3
CO 4	Analyze solid mechanics problems using FEM and commercial FEA software.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction: History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.	15
II	Beam Elements: Flexure Element, Element Stiffness Matrix, Element Load Vector. Method of Weighted Residuals: Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.	15
III	Types: Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature.	15
IV	Application to Solid Mechanics: Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations. Computer Implementation of FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.	15
	Total	60

Text/Reference Books:

1. Finite Element Analysis, Seshu P., Prentice-Hall of India, 2005.
2. Cook R. D., Concepts and Applications of Finite Element Analysis, Wiley J., New York, 1995.
3. Hutton David, Fundamentals of Finite Element Analysis, Mc-Graw Hill, 2004.
4. Zienkiewicz O.C. & Taylor R.L., Finite Element Method, Vol. I, II & III, Elsevier, 2000.

Computer Aided Analysis & Design of Structures (CEE024C20S2)

Scheme of Evaluation: T and P

L-T-P-C: 1-0-3-4, Credit Units: 04

Pre-requisite: Structural Analysis, Design of Structures

Course Objectives:

The objective of the course is to provide foundational knowledge and hands-on experience in structural modeling, analysis and design using advanced CAD software tools relevant to civil engineering. Also to develop the ability to interpret and apply Indian Standard codes for structural design and to analyze or evaluate real-world structural systems through project-based learning.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define the importance and basic principles of CAD tools in civil engineering structural modeling and recognize different types of structures and loadings	BT 1
CO 2	Interpret structural modeling concepts and analysis techniques including static, dynamic and buckling analysis using structural software tools.	BT 2
CO 3	Experiment with software tools to design structural elements (RCC and steel) such as beams, columns, slabs and footings in compliance with relevant IS codes	BT 3
CO 4	Analyze real-world structural problems through case studies and evaluate software output to prepare comprehensive technical reports for a complete structural project.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction: Importance of CAD in civil engineering, Basics of structural modeling, Overview of structural engineering software, Types of structures and loadings. Structural Modeling and Analysis: History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.	15
II	Analysis Techniques: Linear static analysis, Linear dynamic analysis (Response spectrum and time history methods), Buckling and stability analysis, Modal analysis.	15
III	Design of Structural Elements: Design of RCC and steel members using software: Beams, Columns, Slabs, Footings Code compliance: IS:456, IS:800, IS:875, IS:1893, IS:13920 Drawing and Detailing of the structure.	15
IV	Case Studies and Applications: Modeling and analysis of: Simply supported beams; Portal frames; multi-story buildings Project-based learning: Complete modeling, analysis and design of a civil engineering structure, Report preparation and interpretation of software output.	15
	Total	60

Text/Reference Books:

1. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers
2. Ramamrutham S., Design of Reinforced Concrete Structures
3. Structural Engineering Software Manuals and User Guides
4. IS Codes: IS 456:2000, IS 800:2007, IS 875 (Part I-V), IS 1893:2016, IS 13920:2016.

Earthquake Engineering (CEE024C20S3)

Scheme of Evaluation: T

L-T-P-C: 4-0-0-4, Credit Units: 04

Pre-requisite: Advanced Structural Analysis

Course Objectives:

This course aims to equip students with the fundamentals of earthquake engineering, including ground motions, seismic analysis methods, and design principles. It covers ductility-based design, retrofitting techniques, and the role of geotechnical aspects like soil dynamics and liquefaction in ensuring seismic safety of structures.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define the causes, magnitude, and intensity of earthquakes along with historical damage assessments	BT 1
CO 2	Understand seismic analysis methods to evaluate structural responses to seismic loads.	BT 2
CO 3	Apply seismic codes and principles of ductility-based design to create earthquake-resistant structures	BT 3
CO 4	Analyze the dynamic properties of soil and their impact on liquefaction and ground improvement techniques during seismic events.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction to Earthquake Engineering: Earthquakes - causes, magnitude, intensity, Review of damage in past earthquakes. Ground motions and ground motion parameters, Site effects, Sensors, Seismic instruments; Seismic hazard analysis.	15
II	Seismic Analysis: Approximate method of analysis- portal method, cantilever method, McLeod's method, equivalent static method. Response spectrum – concept, construction, characteristics, response spectrum for elastic and inelastic systems, design response spectrum; Center of mass and center of stiffness, Torsionally coupled systems. Linear earthquake analysis - idealization of structures, response spectrum analysis. Nonlinear earthquake analysis - force-deformation relationships, equation of motion, controlling parameters, ductility demand, allowable ductility.	15
III	Seismic Design: Understand seismic codes, provisions related to earthquake resistant design; Philosophy of ductility-based design – deformability, ductility, ductility ratio; Concepts of structural control, Base isolation; Retrofitting and strengthening of buildings and bridges.	15
IV	Geotechnical Aspects: Dynamic properties of soil, dynamic earth pressures, Liquefaction and ground improvement techniques.	15
	Total	60

Text/Reference Books:

1. A. K. Chopra, Dynamics of Structures - Theory and application to earthquake engineering, Pearson Education.
2. T. Paulay and M.S.N. Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley and Sons.
3. R.W. Clough and J. Penzien, Dynamics of Structures, McGraw Hill.
4. M. Paz, Dynamics of Structures, CBS Pub.
5. Aggarwal, P., ShriKhande, M., Earthquake Resistant Design of Structures, McGraw Hills.
6. M. N. S. Priestley, F. Seible and G.M. Calvi, Seismic Design and Retrofit of Bridges, John Wiley and Sons.
7. D. J. Dowrick, Earthquake Resistant Design for Engineers and Architects, John Wiley and Sons.

Research Methodology & IPR (CEE024C20SW1)

Scheme of Evaluation: T

L-T-P-C: 2-0-0-2, Credit Units: 02

Pre-requisite: Nil

Course Objectives:

The main objective is to explain different aspects of research.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Explain key concepts of research methodology and research ethics.	BT 1, BT2
CO 2	Interpret and apply principles of technical writing, research proposals, and plagiarism awareness.	BT 2, BT3
CO 3	Apply Intellectual Property Rights (IPR) concepts to innovation, patent drafting, and protection strategies.	BT 3, BT4
CO 4	Analyze and evaluate recent trends, case studies, and legal issues in IPR.	BT 4, BT5

Detailed Syllabus:

Module	Content	Periods
I	Introduction to Research: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	11
II	Research Ethics & Proposals: Effective literature studies approach, analysis of Plagiarism, Research ethics Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	12
III	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	12
IV	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	10
	Total	45

Text/Reference Books:

1. "Research Methodology: A Step by Step Guide for beginners" Ranjit Kumar, 2nd Edition.
2. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
3. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".

Elective – III: Design of High-Rise Structures (CEE024D20S1)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03

Pre-requisite: Structural Analysis, Design of Structures

Course Objectives:

The objective of the course is to provide in-depth knowledge of the analysis and design of tall buildings, including structural systems, load considerations and seismic performance. It aims to equip students with the skills to apply relevant design codes and modern software tools for evaluating and designing high-rise structures.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Remember structural systems, load types, and materials used in tall buildings.	BT 1
CO 2	Understand design considerations and stability of chimneys and tall structures.	BT 2
CO 3	Apply analysis techniques for tall buildings with and without shear walls.	BT 3
CO 4	Analyze tall buildings using code provisions and seismic isolation methods.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction: Need of tall buildings, Structures elements, Loads on Tall Buildings – Materials for tall buildings, Gravity loads, Live loads, Fire Tender Loading, Wind loads and seismic loading. Design of RC Chimney: Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration.	12
II	Structural Systems: Behavior of various Structural Systems, Types of structural systems for tall buildings, factors affecting growth, height and structural form. Gravity systems, lateral load resisting systems. High rise behavior with moment frame system, braced frames, In-filled frames, shear walls, coupled shear walls, wall-frames, tubular structures, outrigger - braced and hybrid mega systems. Different foundation systems for tall buildings. Analysis of Tall Buildings (With and Without Shear Walls): Shear Walls and their arrangement, Approximate analysis for gravity loads, Lateral loads, Stability, Stiffness and fatigue, Factor of safety and load factor.	11
III	Design of Tall Buildings: Procedures of elastic design, Ultimate strength design and Limit state design of super structures including structural connections, soil structure interaction. Code provisions: Discussion of relevant codes of practices and loading standards, detail discussion for Indian code provisions and other foreign codes, Measures to Reduce the Earthquake Response. Seismic isolations: Introduction to dampers, recent trends in seismic isolations, types of dampers, behavior of friction pendulum system.	11
IV	Applications: Software in analysis and design.	11
	Total	45

Text/Reference Books:

1. Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., South Asian Publishers, New Delhi, 2002
2. Taranath B. S, Structural Analysis and Design of Tall Buildings,. S., Mc-Graw Hill, 1988.
3. Shah V. L. & Karve S. R, Illustrated Design of Reinforced Concrete Buildings (GF+3storeyed), Structures Publications, Pune, 2013.
4. Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 1976.

Elective – III: Project Management (CEE024D20S2)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03

Pre-requisites: Project Management & Economics, Construction Management

Course Objectives:

1. To provide knowledge of basic management practices adopted in civil engineering by using various techniques and softwares.
2. To provide knowledge of various aspects related to site mobilization & workstudy.
3. To provide knowledge of site safety and administration.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Identify knowledge of Construction Management on construction projects.	BT 1
CO 2	Associate project scheduling using various techniques.	BT 2
CO 3	Apply knowledge of work-study on construction site to improve productivity.	BT 3
CO 4	Evaluate safety norms in construction site and decide incentive scheme.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction: Need of tall buildings, Structures elements, Loads on Tall Buildings – Materials for tall buildings, Gravity loads, Live loads, Fire Tender Loading, Wind loads and seismic loading. Design of RC Chimney: Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration.	12
II	Procedures in management: Project clearance procedures and necessary documentation for infrastructure projects, Qualities, role and responsibilities of project Manager, Role of Project Management Consultants. Project Scheduling: Construction Scheduling, Work break down structure, activity cost and time estimation in CPM, PERT, LOB technique, Mass haul diagrams. Precedence Network Analysis.	11
III	Work study:- Definition, Objectives, basic procedure, method study and work measurement, work study applications in Civil Engineering. Method study – Definition, Objective, Procedure for selecting the work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams. Work measurement – Time and motion studies, Concept of standard time and various allowances, time study, equipment performance rating.	11
IV	Applications: Software in analysis and design.	11
Total		45

Text Books:

1. Construction Planning & Management By P.S. Gahlot & B M Dhir , New Age International Limited Publishers
2. Construction Project planning & Scheduling By Charles Patrick, Pearson, 2012
3. Construction Project Management Theory & practice --- Kumar Neeraj Jha, Pearson, 2012
4. Construction Management Fundamentals by Knutson, Schexnayder, Fiori, Mayo, Tata McGraw Hill, 2 nd Edition, 2011 Modern construction management--Harris, Wiley India.
5. Construction Management and Planning by Sengupta and Guha-Tata McGraw Hill publication.

Elective – IV: Applications of GIS in Structural Engineering (CEE024D20S3)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-0, Credit Units: 03

Pre-requisite: Nil

Course Objectives:

1. To provide knowledge of GIS and its applications in structural engineering and natural resource mapping.
2. To develop skills in data acquisition, spatial modeling, and integration of Remote Sensing and GPS with GIS.
3. To enable application of GIS-based spatial analysis and mathematical tools for engineering problems.
4. To introduce advanced topics like Web GIS, 3D GIS, and geospatial programming for infrastructure planning..

Course Outcomes:

On successful completion of the course the students will be able to:

SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Define fundamental GIS terminology and recognize various data models used in structural modeling.	BT 1
CO 2	Interpret spatial relationships and understand the architecture of Web GIS for engineering applications.	BT 2
CO 3	Apply GIS software tools to perform buffer and overlay analysis for site selection and infrastructure planning.	BT 3
CO 4	Analyze real-world engineering problems using spatial modeling and 3D GIS visualization.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction and GIS Components: Geographical concepts and terminology; Utility of GIS in Civil Engineering; Essentials components of GIS; Data acquisition through scanners and digitizers; Raster and Vector data models; Topology and Spatial Relationships.	12
II	Data Preprocessing and Mathematical Operations: GPS Coordinates and Georeferencing; Map Projections; Interpolation of data; Database construction and Management; Spatial and mathematical operations: Buffers, Overlay, and statistical modeling.	11
III	Web GIS and Programming: Programming languages in GIS (Python/R); Web Page Basics and Web Mapping; Geospatial Web Services; OGC-framework; Thin vs Thick Client architecture; Mashup design and implementation.	11
IV	Structural Applications and Advanced Modeling: Applications of GIS to engineering problems and natural resources mapping; Site selection for river valley projects and infrastructure; 3D GIS and virtual GIS; Decision support for transportation and urban planning.	11
	Total	45

Text/Reference Books:

1. Burrough, P.A. and Mc Donnel, R.A., *Principles of Geographic Information System*, Oxford University Press.
2. Ghosh, S.K. and Chandra, A.M., *Remote Sensing and GIS*, Narosa Publishing House.
3. Lo, C.P. and Young, A.K.W., *Concepts and Techniques of Geographical Information System*, Prentice Hall India. Pinde Fu and Jiulin Sun, *Web GIS: Principles and Applications*, ESRI.
4. Chang, K.-T., *Introduction to Geographic Information Systems*, Tata McGraw Hill.

Elective – IV: Advanced Structural Design (CEE024D20S4)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03**Pre-requisite: Structural Analysis, Design of Structures****Course Objectives:**

This course aims to equip students with advanced knowledge in structural design by introducing modeling of loads, material behavior, and performance-based design principles. It covers the strut-and-tie method for D-region elements such as deep beams and corbels, emphasizing its formulation and limitations. Students will understand the seismic behavior and design of shear walls as per IS code provisions. The course also introduces the design of steel structures focusing on stability considerations, including torsional buckling and beam-column interaction.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Remember the design philosophy, load modeling, and material behavior.	BT 1
CO 2	Understand the formulation of the strut-and-tie method for structural components.	BT 2
CO 3	Apply IS code provisions to design and detail shear walls under seismic loading.	BT 3
CO 4	Analyze the stability and buckling behavior of steel members.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction: Design philosophy, modeling of loads, material characteristics. P-M & M-phi relationships.	12
II	Strut-and-tie method: Basic Introduction, Method of formulating strut-and-tie method, Limitations of truss analogy, Design of deep beam, Design of corbel, Numerical Examples.	11
III	Design of Shear Walls: Seismic behavior of shear wall - Lateral Forces on shear wall - Design of shear wall - IS provisions for ductile detailing, Numerical Examples.	11
IV	Steel structures: Stability design - torsional buckling (pure, flexural and lateral); design of beam-columns, Numerical Examples.	11
	Total	45

Text/Reference Books:

1. Pillai, S. U., & Menon, D. (2005). Reinforced concrete design 3rd edition.
2. Varghese, P. C. (2009). Advanced reinforced concrete design. PHI Learning Pvt. Ltd.
3. Ramamrutham S., Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company Ltd, 2007.
4. Krishnaraju N., Design of RCC, CBS publishers.
5. Subramanian, N. (2008). Design of steel structures. Oxford university press.

Repair & Retrofitting of Structures (CEE024C30S1)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03

Pre-requisite: Structural Analysis, Design of Structures

Course Objectives:

This course aims to provide in-depth knowledge of structural distress, deterioration mechanisms, and evaluation techniques. It equips students with an understanding of modern repair materials, methods, and retrofitting strategies for concrete, masonry, and steel structures. Emphasis is placed on the use of non-destructive testing, health monitoring systems, and standards-based approaches to ensure durability and serviceability.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Recall causes and types of deterioration and understand durability aspects.	BT 1
CO 2	Understand inspection techniques and apply NDT tools for condition assessment.	BT 2
CO 3	Apply repair materials and methods for restoring structural integrity.	BT 3
CO 4	Analyze and design retrofitting strategies using relevant standards.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Distress and Deterioration of Structures: Types of structural damage, Causes of deterioration in concrete, masonry, and steel structures, Durability aspects and service life prediction.	12
II	Inspection, Testing, and Evaluation: Visual inspection, Non-destructive testing methods – rebound hammer, ultrasonic pulse velocity, half-cell potential, ground penetrating radar, Load testing of structures, Structural health monitoring systems and sensors.	11
III	Repair Materials and Techniques: Repair materials – polymers, grouts, fiber reinforced composites, Bonding agents, corrosion inhibitors, sealants, Surface preparation and cleaning methods. Repair techniques – epoxy injection, jacketing, shotcreting, stitching, overlays, Design and quality control in repair operations.	11
IV	Retrofitting and Strengthening Methods: Concepts of retrofitting – local and global strategies, Strengthening of RC members – beams, slabs, columns, joints, Use of steel plates and FRP systems, Seismic retrofitting methods – jacketing, bracing, base isolation, Guidelines and standards.	11
	Total	45

Text/Reference Books:

1. Health Monitoring of Structural Materials and Components- Methods with Applications, Douglas E. Adams, John Wiley & Sons Ltd., 2007.
2. Structural Health Monitoring of Civil Infrastructure Systems, Vistasp M.Karbhari and Farhad Ansari, Woodhead Publishing Limited, Oxford Cambridge, New Delhi, 2009.
3. Applications of metaheuristic Optimization Algorithms in Civil Engineering, A.Kaveh, Springer Publications.

Elective – V: Design of Prestressed Concrete Structures (CEE024D30S1)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03

Pre-requisite: Design of Reinforced Concrete Structures

Course Objectives:

The objective of the course is to impart a thorough understanding of the principles, analysis and design of prestressed concrete structures including both determinate and indeterminate systems. It aims to equip students with the ability to apply relevant codes and concepts to real-world design problems involving flexure, shear, torsion and composite construction.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Remember types, systems, materials, and basic prestressing concepts.	BT 1
CO 2	Understand and apply limit state design for flexure, shear, and torsion.	BT 2
CO 3	Apply stress transfer concepts and analyze indeterminate structures.	BT 3
CO 4	Analyze composite members and assess special PSC elements.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction: Types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions.	12
II	Statically determinate PSC beams: Design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.	11
III	Transmission of Pre-stress: Pre-tensioned members; Anchorage zone stresses for posttensioned members. Statically indeterminate structures: Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.	11
IV	Composite construction Analysis and design: Precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack width calculations. Prestressed concrete pipes, columns with moments.	11
	Total	45

Text/Reference Books:

4. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
5. Prestressed Concrete, Krishna Raju N., Tata McGraw Hill, New Delhi, 1981.
6. Guyan Y., Limited State Design of Prestressed Concrete, Applied Science Publishers, 1972.
7. IS: 1343- Code of Practice for Prestressed Concrete.

Elective - V: Analysis and Design of Deep Foundation (CEE024D30S2)

Scheme of Evaluation: T

L-T-P-C: 3-0-0-3, Credit Units: 03

Pre-requisite: Geotechnical Engineering, Foundation Engineering

Course Objectives: The objective of the course is to impart a thorough understanding of the principles, analysis and design of deep foundations including both pile and pile group. It aims to equip students with the ability to apply relevant codes and concepts to real-world design problems involving flexure, shear, torsion and composite construction.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	Course Outcome	Blooms Taxonomy Level
CO 1	Understand the types, functions, and applications of deep foundations, and explain load transfer mechanisms in piles and drilled shafts.	BT 1
CO 2	Analyze subsurface conditions using data from field and laboratory tests (SPT, CPT, soil properties) for foundation design.	BT 2
CO 3	Evaluate the load carrying capacity of single piles under vertical loads in different soil conditions (cohesive and cohesionless soils).	BT 3
CO 4	Estimate settlement and predict load–settlement behavior of piles and pile groups.	BT 4

Detailed Syllabus:

Module	Content	Periods
I	Introduction: Introduction to deep foundations: need, classification, and applications, Types: piles, drilled shafts, caissons, Load transfer mechanisms: end bearing, skin friction, combined action, Subsurface investigation techniques: boring, sampling, in-situ tests (SPT, CPT), Soil characterization and parameter evaluation for design, Influence of groundwater and stratification	12
II	Axial Capacity and Settlement of Piles: Static analysis of pile capacity in cohesive and cohesionless soils, Dynamic pile driving formulas and wave equation analysis, Negative skin friction and downdrag, Load–settlement behavior of single piles, Elastic and consolidation settlement, Pile load testing methods and interpretation	11
III	Pile Groups and Lateral Load Analysis: Pile group behavior and efficiency, Block failure vs individual pile action, Settlement of pile groups, Lateral load analysis: p–y curves, Broms’ method, Piles under combined vertical and lateral loads, Uplift capacity and tension piles	11
IV	Design and Advanced Topics in Deep Foundations Structural design of piles (reinforced concrete, steel, composite piles), Design of drilled shafts and caissons, Design as per Bureau of Indian Standards codes (e.g., IS 2911), Construction techniques and quality control, Foundation behavior under seismic and cyclic loading, Soil–structure interaction in deep foundations, Case studies and recent advances in deep foundation engineering	11
	Total	45

Text/Reference Books:

1. Pile Design and Construction Practice – by Michael J. Tomlinson and John Woodward
2. Principles of Foundation Engineering – by Braja M. Das
3. Foundation Design – by Donald P. Coduto
4. Analysis and Design of Foundations and Retaining Structures – by Shamsheer Prakash and Hari D. Sharma
5. Reinforced Concrete Structures- by Ashok K Jain

Dissertation: Phase-I (CEE024C32SW1)

Scheme of Evaluation: T

L-T-P-C: 0-0-0-14, Credit Units: 14**Contents:**

Dissertation (Phase-I) will include both Mid-Semester and End-Semester presentations. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. The end semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection, analysis of data, determining solutions and must bring out individual's contribution. Continuous assessment at both stages will be carried out by a departmental committee.

Summer Training Report (CEE024C33SW2)**Scheme of Evaluation: T****L-T-P-C: 0-0-0-1, Credit Units: 01****Contents:**

Summer Training is a mandatory component to be undertaken during the summer break following Semester II, in an area relevant to the student's academic programme. The topic shall be finalized in consultation with the proposed Dissertation Guide, under whom the student will pursue Dissertation (Phase-I) in Semester III. As this is a credit course, students must prepare a Training Report and submit it to the Head of the Department. The report will be presented in a departmental seminar before the faculty at the beginning of Semester III. After incorporating any necessary corrections, the final report must be submitted to the departmental library.

Evaluation Pattern:

Presentation before faculty members: 50%

Submission of report: 50%

Semester IV

Dissertation: Phase-II (CEE024C42SW1)

Scheme of Evaluation: T

L-T-P-C: 0-0-0-18, Credit Units: 18

Contents:

Dissertation-II is a continuation of the work initiated in Dissertation-I, focusing on the implementation of the proposed methodology through numerical analysis, experimental work, or data collection and interpretation. Continuous assessment will be conducted during the Mid-Semester and End-Semester by a departmental committee. A pre-submission seminar will be held towards the end of the term. Upon approval, the student must submit a detailed report. A viva-voce examination will then be conducted by an external examiner in coordination with the project guide.
